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Belief manipulation and coping strategies in pain tolerance and pain perception

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Belief Manipulation and Coping Strategies in Pain Tolerance and Pain Perception: A Self-Efficacy Analysis

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Abstract

The present study investigated the effectiveness of two types of pain coping methods: belief manipulation induced by false handwarming biofeedback and real active coping strategies including an overt performance-based technique and verbal-imaginal distraction tasks for enhancing pain tolerance in cold-pressor test. Potential cognitive mediators of pain coping ability were evaluated. After an initial cold-pressor test, thirty four females were assigned randomly to one of three conditions: (a) good handwarming false biofeedback, (b) poor handwarming false biofeedback, and (c) no-treatment control. After a second cold-pressor test, subjects were assigned at random within the two biofeedback conditions: (a) performance of an engaging electronic game, (b) verbal-imaginal self-distraction through mentally demanding activities. They were instructed to apply the coping skill when completing a third cold-pressor test. The control subjects from the earlier phase remained untreated. Before and after each treatment, measures were taken of cold-pressor pain tolerance, self-efficacy, subjective pain and anticipated pain. Results showed that false biofeedback belief manipulation failed to affect coping performance, and had essentially no effect on any other dependent measure, except within the good handwarming biofeedback condition, there was a small but significant increase in self-efficacy strength. For the second type of real coping skills, subjects in the performance strategy condition significantly increased their pain tolerance, self-efficacy, and

decreased anticipated as well as subjective pain feelings, whereas the verbal-imaginal distraction subjects did not. Self-efficacy was a highly accurate predictor of tolerance throughout the three cold-pressor tests which supported Bandura's theory that self-efficacy was a mediator of people's ability to behaviorally cope with pain.

CHAPTER 1

Introduction

Pain is a common noxious experience. More than 80% of the visits to physicians are for pain-related problems (Bresler, 1979). The pervasiveness of human pain is also manifested by annual billions of dollars spent on pain medications. One dimension of pain is the aversive feeling of hurting, the pain itself. Another important dimension of pain is behavioral tolerance which refers to the duration of time an individual can endure a painful stimulus and function in spite of it. In this sense, pain is not merely a sensation or feeling, but creates behavioral problems such as withdrawal from normal functional activities unless people possess some capacity for pain tolerance.

Historically, pain was viewed as a straightforward response to the stimulation of pain receptors, and as a sign of illness or injury. Accordingly, pain research focused on neurophysiological mechanisms of pain transmission, and the only solution to pain was thought to be by medical or physiological intervention.

The view that pain was purely physical was cast into doubt by the finding of substantial variability between as well as within individuals in the amount of pain they feel after injury, and in how they react behaviorally to feelings of pain. This can be illustrated by Beecher's classic early study (1946) in which he compared battle and civilian wounds. His findings indicated that both the degree and duration of pain from a given wound was unpredictable. There was virtually no dependable relation between the extent of a pathological wound and the pain experienced.

Knowledge of neurophysiological aspects of pain has produced some partly successful somatic pain treatments. Nevertheless, pain coping methods such as surgery and drugs suffer from serious limitations. Above all, analgesic drugs and surgery are not always effective in producing pain relief. In some cases, they fail to alleviate pain at all, even if, according to physiological conceptions of pain, they should eliminate it. Moreover, new pains are frequently reported after analgesic surgery (Melzack, 1973); and drugs may produce negative side effects and addiction. It is clear now that somatic pain coping methods alone do not and probably cannot achieve optimal pain relief.

The strong role of psychological factors in pain tolerance and perception is illustrated by the effectiveness of placebo pills which contain no ingredients that could actively affect either the underlying pain-evoking physiological process or the neural pathways for pain transmission (Fields & Levine, 1981). Placebos have been shown to consistently lead to pain reduction and tolerance increment in about one-third of pain sufferers (Weisenberg, 1977). Patients receiving placebo administration not only improve their ability to moderate pain, but also display some of the characteristics of pharmacologically active drugs, such as withdrawal symptoms and even biochemical effects (Levine, Gordon, Bornstein, & Fields, 1979). The effectiveness of placebos on pain and tolerance implies clearly that there must be some psychological factors involved in pain and pain tolerance.

Pain and tolerance are now well known to be affected by a wide variety of psychosocial influences. These include environmental context (Beecher, 1951), social modeling (Craig, 1984), attentional focus (Blitz and Dinnerstein, 1971), perceived control over the painful stimulation (Glass, Reim & Singer, 1971; Miller, 1979), the availability of cognitive coping strategies (Chaves & Barber, 1974) and many others (Weisenberg, 1977). Since this is the case, we may help individuals to confront pain by manipulating these corresponding psychological factors in addition to or instead of applying somatic means (Melzack, 1973; Weisenberg, 1977; Tan, Melzack & Poser, 1980).

Perhaps the most prominent and widely used non-medical pain coping methods are relaxation training and cognitive coping strategies. Relaxation training provides instructions on slow deep breathing and the release of muscle tension. Cognitive coping treatments emphasize distracting one's attention from pain perception by concentrating on non-pain activities such as engrossing mental exercises, or by pleasant imagery in which people imagine positive events instead of attending to the noxious sensations of pain.

A somewhat different cognitive approach concerns cognitive appraisal of pain. By this view, coping strategies can reduce pain when individuals are led to reinterpret the context and the significance of the painful stimulation. Reappraisal methods may include self-verbalization in which people learn to use internal speech to calm themselves and refrain from reacting to the pain.

All of the above mentioned psychological coping techniques have been found at least somewhat effective in helping individuals to increase pain tolerance and to reduce both the amount of pain they experience and the amount of pain medications they ask for (Barber & Cooper, 1972; Genest, 1978; Turk, 1979; Wernick, Jaremko & Tayor, 1981). What then are the mechanisms underlying the effectiveness of various psychological strategies in regard to pain and tolerance regulation?

The most influential psychological theory of pain was Melzack and Wall's gate control theory (1965), which postulated a neural spinal gate control mechanism that is able to open and close in response to brain efferents allowing different amount of neural impulses from the periphery to pass through. The neural "gate" in this way controls the flow of sensory information transmission. Within the gate control mechanism, central control factors serve as internal stimuli that influence the width of the "gate". Thus gate control theory acknowledged the role of psychological factors in pain perception, while continuing to hold that the physical sensations reaching the brain are the major proximal determinants of pain experienced.

While the gate control mechanism, and the view that pain is wholly determined by sensations arriving from the neurological periphery, are controversial, newer approaches are concerned more directly with the central regulation of pain. According to these newer theories, the sensory aspects of painful stimulation account for only part of the pain experience, and the remaining part is explained by individuals' cognitive and emotional reactions to the incoming stimulation. These theories have spawned various psychological treatments for pain. Relaxation treatment is mainly based on the conception that anxiety is the affective component of pain (Corah, Gale, Pace & Seyrek, 1981; Melzack, 1973), and that relaxation inhibits anxiety. Although relaxation training does indeed tend to reduce pain and increase tolerance, anxiety theory cannot explain sufficiently the pain-reducing effects of relaxation. For example, Linton and Gotestam (1983) found that relaxation increased pain tolerance without decreasing anxiety, suggesting that the relaxation strategy must operate via a mechanism other than anxiety inhibition. Cognitive distraction treatments for pain derive from attentional theory (McCaul & Malott, 1984), which is concerned with the attention paid to painful sensation. Briefly, this theory holds that attention to pain determines pain, and because attentional capacity is finite, an attentionally demanding preoccupation should be effective in reducing pain. Attention distraction strategies have been found consistently effective in attenuating pain and enhancing tolerance (Turk, Meichenbaum & Genest, 1983), although the postulated attentional mechanism has not been extensively tested.

Bandura has drawn attention to the possible influence of perceived self-efficacy in pain tolerance and perception. Bandura (1977) proposed that an individual's self-perceived ability to perform coping responses has a strong effect on coping behavior, thought, and emotion. In the context of pain, self-efficacy refers to one's perception of one's ability to control and reduce pain, to tolerate pain, or to effectively employ a pain coping strategy (Bandura, 1986). In Bandura's view, perceived self-efficacy influences psychosocial behavior in several ways. Perceived coping efficacy influences the choice of activities and whether individuals initially will attempt to cope with an aversive situation or simply not try. If they do try, self-efficacy will then affect how hard they try, and how long they persist. Based on the theory, the more efficacious they judge themselves to be, the more efforts they will make and the longer time they will spend trying a given coping task, and the less aversive they will find the task (Bandura, 1986).

Based on self-efficacy theory, psychological means of pain coping influence pain and pain tolerance partly by altering people's perceptions that they have effective means of coping at their disposal. An individual's sense of self-efficacy comes from several different sources of information, including vicarious experience, performance accomplishments, and verbal persuasion. According to Bandura (1977), the most potent source of self-efficacy is performance accomplishments. Firsthand successes or failures tend to orient one's judgment of self-efficacy toward what one has actually accomplished.

Merely verbally persuading subjects to believe that they have the capability to control pain or that a particular coping technique is effective, might influence self-efficacy, but because it provides less trustworthy evidence of what one can do, it should tend to be less potent or enduring than firsthand success experiences (Cervone, 1987). A manipulation that involves no actual coping skill would seem to enable a particularly clear test of the self-efficacy mechanism in that any effect on pain tolerance would be achieved by imparting only the belief that one can cope. However, once a person is actively trying to cope with pain, the firsthand coping experiences are likely to quickly override beliefs based on mere persuasion. In contrast, if people are prepared with a functional pain coping skill, they should gain a more resilient sense of self-efficacy that will endure past initial encounters with pain.

Instilling the belief that one possesses an inherent pain coping ability does indeed enhance pain tolerance. Neufeld and Thomas (1977) gave subjects bogus feedback about their success in relaxation while receiving a cold pressor test, and found that people told that they had been relaxing effectively increased their pain tolerance nearly twice as much as did people told that they had not been relaxing effectively. The significant difference in pain tolerance between the two groups appeared attributable to differences in self-efficacy for coping with pain rather than actual skill differences. Similarly, Litt (1988), in his second experiment, attempted to manipulate self-efficacy via a false biofeedback procedure in which he gave subjects biofeedback tones designed to make them believe that they were either effective ("good") or ineffective ("bad") in warming their hand. Those in the good handwarming condition subsequently tolerated cold-pressor pain significantly and substantially longer than did those in the bad handwarming condition. The tolerance time for the subjects in good handwarming condition was more than three times longer than that of subjects in the poor handwarming condition. However, neither Litt's (1988) second study nor Neufeld and Thomas's (1977) study measured subjects' self-efficacy, so whether the effectiveness of the bogus feedback treatments was mediated by changes in perceived self-efficacy was not directly tested. Nevertheless, Litt's (1988) finding suggests an apparently powerful belief manipulation for producing massive change in tolerance merely by attempting to instill a false belief in one's handwarming capabilities.

Two studies have manipulated beliefs while examining more directly the role of perceived self-efficacy on pain tolerance change. Holroyd et al. (1984) investigated the role of self-efficacy in the treatment of tension headache. Subjects in one condition were given bogus electromyographic (EMG) biofeedback indicating that they had efficiently learned to reduce frontalis muscle tension, while the remaining subjects received bogus feedback indicating they had failed to efficiently reduce muscle tension. The results revealed that regardless of actual changes in EMG activity, subjects in the success condition showed substantially greater improvement in self-rated headache frequency and intensity than did subjects in the failure condition. Correlational analysis revealed that regardless of condition, change in self-efficacy was significantly correlated with improvement in headache activity, whereas actual EMG changes were uncorrelated with improvements in headache activity. These findings suggest that the effectiveness of EMG biofeedback training was mediated by changes in self-efficacy and not by changes in actual EMG activity.

Similarly, in Litt's (1988) first experiment, subjects completed an initial cold-pressor test, and then were told either that they had performed very well or that they had performed poorly, irrespective of actual performance. Subjects in a control condition received no appraisal of their performance. Subjects then made self-efficacy ratings of their ability to tolerate cold-pressor pain, then completed a second cold-pressor test. The effects of the false information on their performance were modest yet significant, with the "good performance" subjects showing more increase in tolerance than the "poor performance" subjects. In addition, changes in self-efficacy strongly predicted changes in cold-pressor tolerance in both groups. Litt (1988) concluded that self-efficacy could be a contributing determinant of pain coping behavior.

Although there is some evidence to suggest that belief induction might operate though the self-efficacy mechanism, the effects of belief manipulation on pain coping are generally moderate. A notable exception to the usually moderate effect of belief induction was the immense increase in tolerance achieved by false handwarming biofeedback in Litt's (1988) second study. It is of great interest to determine whether this strikingly effective belief manipulation achieved its effects through the mechanism of self-efficacy enhancement.

The second general approach to testing the self-efficacy mechanism is to provide subjects with some authentic skill-based coping techniques, and then investigate whether any resultant individual changes in pain tolerance are well predicted by the individual changes in perceived self-efficacy. In this approach, people are given a presumably genuine coping skill (e.g. muscle relaxation training, attention distraction technique) that is known to empirically influence behavior. Such strategies might in principle do more to help people cope with pain than would be achieved by mere change in beliefs.

Several studies have been conducted with active pain coping strategies to test the role of self-efficacy on pain and pain tolerance. Turk, Meichenbaum and Genest (1983) from their extensive program of pain coping research, drew the general conclusion that only subjects who achieve a strong sense of self-efficacy and of the ability to remain in control show high pain tolerance, although these investigators did not report the efficacy-behavior correlation directly.

Reese (1983) directly studied the effect of several active treatments and a control condition on perceived self-efficacy and cold pressor pain tolerance. In a cognitive coping condition, subjects were taught how to use cognitive techniques including attention diversion, positive imagery, dissociation, and self-verbalizations. Subjects in the relaxation training group were taught how to use muscular relaxation to reduce pain. Self-efficacy and pain tolerance were assessed after treatment. Results showed that all treatment groups increased significantly in perceptions of self-efficacy. Changes in self-efficacy in general corresponded well with intergroup treatment effects. Irrespective of previous treatment condition, self-efficacy correlated .80 with pain tolerance after treatment, suggesting that perceived self-efficacy might have largely mediated the effects of various treatments on cold-pressor pain tolerance.

In another study, Kinney (1987) compared the effectiveness of several pain coping techniques in altering self-efficacy and pain tolerance: (a) verbal-imaginal distraction in which people were instructed to employ positive imagery or do mental arithmetic during a subsequent cold-pressor test, (b) overt performance distraction in which subjects were asked to play a small electronic game during the cold-pressor test, and (c) relaxation training in which subjects were taught to release muscle tension while enduring pain. A fourth group of subjects received no treatment. Results demonstrated that performance distraction was the most effective method to enhance cold water pain tolerance, and all active treatments produced significant increase in pain tolerance compared to the control condition. The electronic game performance was significantly superior to the cognitive distraction and relaxation conditions in enhancing behavioral tolerance. Irrespective of treatment condition, there was a high correlation between self-efficacy and pain tolerance ($r = .84$) at posttreatment. In other words, individuals whose self-efficacy was raised to high levels by a given pain coping technique showed better tolerance when applying the technique than did individuals whose self-efficacy was not high.

An important question is whether actual skill-based pain coping techniques enhance tolerance beyond the effects of persuasion-altered self-efficacy beliefs alone. If so, then do they do this by instilling more potent beliefs in self-efficacy, by providing better distraction, or both? More specifically, the question is whether the changes in tolerance induced by a nonskill belief manipulation (such as Litt's (1987) false good handwarming biofeedback procedure) could be enhanced still further by subsequently adding a genuine pain coping skill. If people were first given Litt's false handwarming biofeedback that they are good or poor handwarmers, and then were given an actual skill-based treatment such as a distraction based strategy, what would happen? Presumably two types of results might occur. One possibility is that the skill-based treatment might override the effects of the previous belief manipulation. That is, regardless of the differences in self-efficacy and pain tolerance induced by the good/poor false biofeedback procedure in a first treatment phase, the subsequent pain coping skill will enable all subjects to reach the same level of self-efficacy and pain tolerance irrespective of previous false biofeedback. A second possibility is that the effect of the belief manipulation would remain only as a constant base upon which the second skill-based strategy would exert an additional effect in helping individuals to increase self-efficacy and pain tolerance. In other words, the good and poor handwarming biofeedback groups would remain significantly different even after receiving a genuine coping skill. If the self-efficacy beliefs instated by false biofeedback were stable, and the coping strategies added to pain tolerance beyond mere belief change, one would expect an additive effect in which the effects of the false biofeedback would remain evident even after subjects began employing an active coping strategy. Neither previous research nor self-efficacy theory itself yield a clear prediction of which pattern should be found. Nevertheless, the answer to this question could give potentially important information about the relative contribution of coping skills and self-efficacy beliefs to pain tolerance, and about the process of forming and maintaining a judgment of one's coping abilities.

The present study was designed to address this question. After an initial cold-pressor test, subjects received false biofeedback that they were either good handwarmers or poor handwarmers, or they were assigned to a control condition in which they received no feedback. After a second cold-pressor test, subjects within the two biofeedback conditions were reassigned at random to one of two coping skill conditions: overt performance distraction (referred to simply as the "performance distraction" condition hereafter) and verbal-imaginal distraction. These two coping strategies were selected because they can be taught to subjects very quickly, and because previous research (Kinney,

1987) found performance distraction to be significantly more effective than verbal-imaginal distraction. Subjects were instructed to apply the coping skill when completing a third cold pressor test. The control subjects from the earlier phase remained untreated. Perceived self-efficacy for tolerating pain was measured both before and after each treatment phase.

In addition to perceived self-efficacy, the study sought to evaluate the role of anticipated pain, or the amount of pain people anticipate experiencing while coping with the cold pressor task. Expected outcomes of behavior have been widely proposed as cognitive determinants of coping, and anticipated painful outcomes in particular have been proposed to have a bearing on pain tolerance (Melzack, 1973). In addition, some critics of self-efficacy theory (e.g. Kazdin, 1978) have argured that people's expected outcomes of behavior are the primary determinants of action, and that perceptions of self-efficacy derive from and are redundant with outcome expectations. Because the pain one anticipates experiencing is a salient outcome of tolerating a painful stimulus, anticipated pain was also measured at each assessment phase. This measure thus permits evaluating the relative contribution of outcome expectations and efficacy judgments to cold pressor tolerance.

I predicted that (a) subjects in the good handwarming condition would tolerate pain much longer than those in the poor handwarming condition, (b) subjects in the performance distraction condition would tolerate pain longer than those in verbal-imaginal distraction condition, (c) behavioral changes in tolerance, regardless of treatment technique or experimental condition, would be predicted by changes in perceived self-efficacy, (d) that perceived self-efficacy could predict pain tolerance independently of anticipated pain, and (e) although there is no clear basis for predicting the result, it is of great interest to explore the relationship between the effects of belief manipulation induced by false biofeedback and the effects contributed by subsequent real coping strategies.

CHAPTER 2

Method

Design

A schematic representation of the experimental design is shown in Appendix A.

Subjects

Subjects were 34 female undergraduate students drawn from Lehigh University's Psychology and Social Relations Departments' subject pool. Females were chosen because they tend to have substantially lower pain tolerance than do males, thereby allowing more room for improvement over the course of the experiment.

Preliminary Procedures

All subjects were seen individually. After being informed of the nature of the study, subjects completed a brief preliminary screening interview to identify those with a medical reason not to participate (e.g. previous frostbite, arthritis, recent hand surgery). No potential subject was excluded. Subjects were then told to give their watches to the experimenter until the end of the study. This ensured that they would not have differential access to an objective measure of the length of the hand immersion time during the cold-pressor test. All jewelry on the non-dominant hand was removed.

First Assessment Phase

Warm water immersion. Subjects then immersed their nondominant hand in a container of warm water for three minutes to minimize hand temperature differences between individuals. The water was kept at body temperature (37^{o} C) by a thermostatic heating coil.

Trial cold-pressor immersion. To familiarize the subjects with the painful stimulus, they then completed a 30-second trial cold-pressor immersion in a plastic tub filled with ice water and maintained at $.5^{o}$ C. A plastic screen prevented subjects' hands from coming into direct contact with the ice. Subjects were instructed to place their hands into the ice water bath up to their wrists with the middle finger on a red cross at the bottom of the tub. The experimenter instructed them to keep their hand immersed in the ice water for as long as they could. When thirty seconds had elapsed, the experimenter asked the subjects to remove their hand from the cold water. Nine subjects who were unable to keep hand immersed for the full 30 seconds were excluded so that subjects would not differ in cold-pressor performance prior to the remaining procedures.

Self-efficacy rating. Subjects then completed a self-efficacy scale [see Appendix B] on which they indicated their self-perceived ability to tolerate pain. Subjects rated how confident they were that they could keep their hand immersed in ice water for each of 18 time periods ranging from 20 seconds to 6 minutes with 20 second intervals. Ratings were made using a confidence scale from 0 ("cannot do") to 100 ("certain"), with scale labels at 10 ("quite uncertain") and 50 ("moderately certain") [see Appendix B]. Self-efficacy strength was scored as the mean of the confidence ratings for the 18 intervals.

Self-efficacy level was scored as the percent of items subjects rated with a confidence value of 20 or above. The measurement format and scoring procedures for perceived self-efficacy were identical with those of the single-response format recommended by Bandura (1984).

Anticipated pain rating. Subjects then rated how much pain they thought they would experience if they were to immerse their hand in the cold water bath for each of the 18 time periods ranging from 20 seconds to 6 minutes in 20 second intervals, using the form shown in Appendix C. Ratings for each interval were made using a scale from 0 ("not painful") to 10 ("extremely painful"). The mean of the ratings for the 18 intervals was taken as the anticipated pain score.

Both the self-efficacy and anticipated pain scales were administered immediately before and after each experimental treatment so that the effect of the treatments on self-efficacy and anticipated pain could be assessed without any intervening effects of the cold pressor test itself.

First cold pressor test. Subjects were then instructed to submerge their hand in the cold water bath for as long as they could endure. The experimenter measured immersion time with an electronic stopwatch. Pain tolerance was recorded as the length of time a subject's hand remained in the cold water. After six minutes, the experimenter asked the subject to remove her hand if she still had it immersed. Six potential subjects who could tolerate pain for four minutes on this first cold-pressor test were excluded from the study as being insufficiently intolerant, leaving a total of 34 subjects.

Subjective pain ratings during cold-pressor test. During the cold-pressor test subjects were instructed to orally respond to beeps given at 20 second intervals by stating aloud how painful their hand was feeling at that moment, using the 0-10 pain scale shown in Appendix D. Subjects then completed another set of self-efficacy and anticipated pain scales identical to those completed before the cold-pressor test.

Biofeedback Conditions

After the pretreatment assessment procedure, subjects were randomly assigned into one of three conditions: "good" handwarming false biofeedback, "poor" handwarming false biofeedback, and a non-biofeedback control condition. The false biofeedback procedure was patterned as closely as possible after Litt's (1987) procedure, including Litt's verbatim instruction to subjects. In the good and poor biofeedback conditions, subjects were told that "the best thing I can tell you to do while you are hooked up to the machine is to perceive your hand as feeling warm. Once the process is set in motion, people who are good hand warmers seem to be able to effectively keep their hand warm. So essentially, you should just perceive your hand being warm". They were also told that if they could successfully warm their hand, they would feel less cold and hence less pain during the cold pressor test [see Appendix E for the verbatim biofeedback instruction to subjects]. The experimenter attached a thermistor to the subject's non-dominant hand with a wire leading to a biofeedback apparatus. The actual biofeedback mechanism was disconnected. When turned on, the machine in reality activated an electronically-produced tone recorded on cassette tape concealed near the biofeedback machine. Subjects were told that the more frequently they heard the tones, the more effectively they were warming their hand. Subjects in the good handwarming condition heard the tones, on average, 8 sec out of every 10 sec during biofeedback training; subjects in the poor handwarming condition heard the tones only 2 sec out of every 10. Subjects were not told what the frequency of tones meant, and thus they had to infer the meaning on their own. The false biofeedback training lasted for five minutes.

Control subjects did not receive any treatment. They simply rested for a time interval equal to that of the biofeedback conditions (five minutes), then proceeded with the second assessment phase procedures.

Second Assessment Phase

After false biofeedback or waiting-control, subjects again completed the self-efficacy and anticipated pain ratings, then underwent a second cold-pressor test identical with the first. They then completed another set of self-efficacy and anticipated pain ratings, and then began the coping strategy training phase of the experiment.

Strategy Conditions

Subjects within the previous biofeedback condition were randomly assigned to either an overt performance coping strategy condition or a verbal-imaginal distraction coping strategy condition. The control subjects remained in a control condition in which they were simply told to wait for a period of five minutes corresponding to the time their treated counterparts spent learning their coping strategies.

Subjects in the performance distraction condition were given 5 minutes of instruction and practice in playing a small pocket electronic game called "Popeye" [see Appendix F for the verbatim instructions to these subjects]. The game was played by pressing two buttons to maneuver Popeye around to catch objects thrown by Olive Oyl and to avoid the fists of Bluto. If subjects did nothing, Popeye was soon defeated. Subjects could restart the game immediately by pressing a reset button. The game was fastened to a table in front of subjects so they could play it with their dominant hand while keeping their nondominant hand immersed.

Subjects in the verbal-imaginal distraction strategy condition were given 5 minutes of instruction and practice in a variety of verbal-imaginal skills to use in coping with pain [see Appendix G for verbatim instructions to these subjects]. These skills included attention diversion and dissociation. Attention diversion consisted of concentrating on mentally engrossing activities or imagining a pleasant scene. Subjects were told that they could concentrate their attention on a non-pain activity or experience, thereby diverting their attention away from the cold-pressor pain and lessening its impact on them. Several specific suggestions of such tasks were made including solving arithmetic problems; making mental list of the states in the United States; using vivid imagery such as imagining their last birthday party or the first day of college. Dissociation was described to subjects as another way to cope with pain, by mentally separating the part of the body in pain from the rest of the self. They were told to perceive that their hand was totally separate from them, or that their hand was made of something else. Subjects were informed that these strategies had been found to have the capacity to increase pain tolerance, and that they should use the strategy of their choice during the third cold pressor test.

Third Assessment Phase

After the strategy training, subjects completed a third assessment procedure that was identical with the previous two except that strategy subjects were told to employ the distraction technique they had just learned.

Debriefing

Subjects were thoroughly debriefed at the end of their participation in the study [see verbatim debriefing statement in Appendix I].

CHAPTER 3

Results

Pretreatment Differences Between Groups

Prior to analyzing treatment effects, one-way analyses of variance (ANOVAs) were conducted on the pretreatment means for the initial treatment groups on the various measures. The results indicated that subjects in the good handwarming, poor handwarming, and control conditions did not differ significantly from one another on any of the dependent measures prior to treatment.

False Biofeedback Effects

The means achieved by the subjects in the initial treatment conditions at the first and second assessment phases are presented in Table 1, with the results for the measure of behavioral tolerance graphically displayed in Figure 1. To investigate effects of false handwarming biofeedback technique on thoughts, feelings, and behavior, two-way (treatment conditions x assessment occasions) ANOVAs were carried out on these means, with the results shown in Table 2. The changes from first to second assessment within groups were analyzed by *t*-tests for matched pairs. Within the good handwarming biofeedback condition, there was a small but significant increase in self-efficacy strength, but no significant change in self-efficacy level, or in tolerance, subjective pain, or anticipated pain. Within the poor handwarming group and the control group, there were no significant changes on any measure except that control subjects significantly decreased their anticipated pain.

The analyses of intergroup differences reported in Table 2 reveal that good handwarming subjects did not change differently from poor handwarming subjects on any measure; the experiment thus failed to replicate Litt's (1987) finding in this regard. The good handwarming group showed a significantly greater increase in self-efficacy ($p < .05$) and a nearly significantly greater increase in pain tolerance ($p < .06$) than those in the control condition, whereas the poor handwarming and control groups did not change to a significantly different extent on any measure.

Verbal-imaginal versus Performance Based Distraction Effects

The second phase of the experiment involved the performance distraction, verbal-imaginal distraction, and control groups. Because there was no difference between good and poor biofeedback conditions in the previous phase, analyses of variance comparing the verbal-imaginal and performance treatments were carried out disregarding previous treatment conditions. Presented in Table 3 are the mean scores from the second and third assessment phases for subjects in each strategy condition. Within-group changes were analyzed by t-tests shown in upper section of Table 4, and comparisons between groups tested by two-way (treatment conditions x assessment phases) analyses of variance shown in Table 4.

Pain tolerance. Presented in Figure 2 are changes in tolerance time. Analyses of the changes within groups (top section, Table 4) indicate that only the performance distraction strategy condition significantly increased tolerance time.

Verbal-imaginal distraction increased subjects' tolerance time only to a marginally significant extent ($p < .10$) as indicated by a t-test, but to a significant extent ($p < .05$) with the nonparametric sign test. Control subjects showed no significant improvement in tolerance. The intergroup comparisons (bottom section, Table 4) showed that the performance distraction subjects increased significantly more in tolerance than did control subjects, but not significantly more than verbal-imaginal treatment subjects; however, because there was a very skewed distribution of the data from the verbal-imaginal condition, the data were reanalyzed using the distribution-free Mann-Whitney U-test. The computation compared the pre- to post treatment difference scores of the two conditions. This analysis revealed a nearly significant difference between the performance and verbal-imaginal conditions in tolerance change ($p < .06$). The Mann-Whitney test also revealed that verbal-imaginal subjects' tolerance increased significantly more than did control subjects', ($p < .05$). As Siegel (1956) states "for some population distributions a nonparametric statistical test is clearly superior in power to a parametric one" (p.32). Siegel points out that this is likely to be true, for example, when the distributional assumptions of parametric tests are not met by the data, as in the present case.

Subjective pain. Intragroup t-tests from Table 4 demonstrated that subjects in the performance distraction condition experienced significantly less pain on the third cold pressor test than that on the second, but the verbal-imaginal strategy and control subjects did not change significantly. The intergroup comparisons in Table 4 revealed that the performance distraction strategy was significantly more effective than either the verbal-imaginal distraction strategy or the control condition in reducing subjective pain. The verbal-imaginal and control groups did not significantly differ in pain reduction.

<u>Perceived self-efficacy strength and level.</u> The analyses of the self-efficacy data shown in Table 4 revealed that the performance distraction strategy users significantly increased in self-efficacy, whereas verbal-imaginal strategy and control subjects failed to change significantly. The intergroup analyses indicated that performance distraction subjects increased their self-efficacy level and strength significantly more than did the verbal-imaginal distraction and control subjects. The verbal-imaginal and the control subjects did not change differently in self-efficacy.

<u>Anticipated pain.</u> Subjects in the performance distraction condition showed a significant but modest decrease in amount of pain they anticipated, whereas the verbal-imaginal distraction and control subjects did not change. Intergroup comparisons showed that these groups did not differ significantly in change in anticipated pain (Table 4).

<u>Analyses of Possible Mediators of Pain Tolerance</u>

The fourth hypothesis was that perceived self-efficacy would predict pain tolerance independently of anticipated pain.

Analyses of the possible cognitive mediators sought to determine whether self-efficacy or anticipated pain was the more accurate predictor of subsequent cold pressor tolerance at each assessment phase. Intercorrelations among the various measures at each phase are shown in Table 5.

Both self-efficacy strength and level correlated significantly with tolerance behavior at all three assessment phases, and were especially high at the second and third assessment phases. Self-efficacy did not predict subjective pain at any phase.

Anticipated pain was also significantly and strongly correlated with tolerance at all phases. Anticipated pain correlated modestly but significantly with subjective pain during the second and third assessments, but not at the first assessment.

Subjective pain was not correlated with tolerance at the second and third assessments, and was modestly positively correlated with tolerance at the first assessment (i.e. the higher the pain, the longer the tolerance). These findings are in accordance with Kinney's (1987) results in which pain tolerance was clearly not inversely determined by the degree of pain experienced.

Self-efficacy and anticipated pain were strongly and significantly correlated with one another. To determine the extent to which each cognitive factor depended upon the other for its capacity to predict tolerance, partial correlation coefficients were computed. The results showed that when self-efficacy was held constant, the correlations between anticipated pain and tolerance at the three assessment phases were $r = -.30$, $p < .05$, $r = -.03$ and $r = .13$. When anticipated pain was partialed out, the correlations between self-efficacy and tolerance time were $r = .03$, $r = .30$, $p < .05$, and $r = .51$, $p < .01$ for the three assessments respectively. In the second and third assessments, self-efficacy remained significantly correlated with tolerance time independently of anticipated pain, whereas anticipated pain lost its capacity to predict tolerance independent of self-efficacy. These findings support the self-efficacy position (expressed in the fourth hypothesis) that perceptions of self-efficacy do not depend upon the outcome expectation of anticipated pain for their capacity to predict the effects of treatment manipulations on pain tolerance.

CHAPTER 4

Discussion

The present study was aimed at examining the role of perceived self-efficacy in the effectiveness of psychological treatments for coping with pain, and to examine the separate and combined effects of belief manipulation and actual coping strategies on pain tolerance and perception. Subjects received a non-skill belief manipulation in a first experimental phase, then received an active behavioral/cognitive coping technique in the second experimental phase. Unfortunately, the findings from the first half of the experiment failed to support the effectiveness of the belief manipulation, as this manipulation did not affect coping performance and had essentially no effect on the other dependent measures except self-efficacy strength (but not self-efficacy level). Unfortunately, the attempt to explore belief-skill interaction was rendered moot by the absence of the false biofeedback effect.

The false biofeedback procedure conscientiously followed Litt's (1987) procedure in every respect except two, namely, (a) Litt (1987) did not measure self-efficacy after false biofeedback whereas the present study did, and (b) Litt did not employ a cold pressor test prior to false biofeedback whereas the present study did. The failure to replicate the effectiveness of Litt's (1987) false biofeedback manipulation was probably due primarily to the pre-biofeedback behavioral test. This kind of pre-biofeedback cold-pressor test might have well undermined the biofeedback manipulation by constraining subjects' perceptions of self-efficacy in light of their actual behavioral test performance. If they had not had any firsthand cold-pressor pain experience, they might well have been persuaded of their own effectiveness or ineffectiveness by the false biofeedback. But having learned what they could tolerate, subjects would not likely change their beliefs or tolerance much in light of the new, less directly relevant, false biofeedback information. It was therefore a strategic mistake to give subjects such powerful firsthand evidence of their ability to endure pain prior to trying to instill the belief that they should be good or bad at tolerating pain. Evidence for the dampening effect of a pretreatment behavioral test on false biofeedback effectiveness is the recent finding of Goldbach (1987), who gave subjects the false biofeedback manipulation at the very beginning without any cold-pressor pretest; then measured self-efficacy and cold-pressor tolerance. The findings showed a significant advantage for the good biofeedback subjects over the poor biofeedback subjects in posttreatment tolerance. Subsequent studies of the biofeedback manipulation thus should omit the behavioral pretest.

The second hypothesis, derived from Kinney's (1987) finding, was that the performance distraction skill would enhance subjects' pain tolerance to a greater degree than would the verbal-imaginal distraction method. The results supported this hypothesis.

Subjects who engaged in playing the electronic game during cold pressor test significantly increased their pain tolerance, whereas the verbal-imaginal coping subjects did not, and the groups differed in change in tolerance to a degree that closely approached significance ($p < .06$) on the Mann-Whitney $\underline{U}$-test. Further analyses revealed that performance subjects increased not only their pain tolerance, but also self-efficacy both in terms of its strength and level, and decreased anticipated as well as subjective pain feelings after the skill-based pain coping strategy training. Thus, as Kinney (1987) also found, having subjects engross themselves in an attentionally demanding overt activity had a strong beneficial effect on reducing pain and increasing tolerance. The verbal-imaginal coping method was also effective in that verbal-imaginal subjects showed a significantly greater improvement in tolerance than did control subjects on the Mann-Whitney test.

The third prediction was that behavioral changes in tolerance, regardless of treatment condition, would be mediated by changes in perceived self-efficacy. The prediction was supported by the high correlation between self-efficacy and tolerance at all three assessments, with the critical post-manipulation assessments (2 and 3) showing particularly high efficacy-behavior correlations of .71 and .66. Regardless of the treatment groups into which the subjects were assigned, those who had higher self-efficacy of their performance were inclined to tolerate cold pressor pain longer than those who had lower self-efficacy.

In addition, the intergroup differences in tolerance produced by the coping skill manipulation were generally matched by intergroup differences in self-efficacy even before subjects had an opportunity to apply the coping skills in the third cold-pressor test. These findings suggest that perceived self-efficacy might have an influence on tolerance behavior. Yet the conclusion does not, by any means, rule out the importance of attention. While self-efficacy appears to be one major contributing factor in pain tolerance, attention to pain sensations is another factor that might well exert an impact on pain endurance independently of self-efficacy. Bandura (1987) acknowledges the influential role of attention in pain and pain tolerance, but argues that perceived self-efficacy helps people to divert their attention. "Perceived self-efficacy can lessen experienced pain by diverting attention from pain sensations to competing engrossments" (P. 564). Bandura then argues that the ability to divert attention from a stressor depends in part on one's self-efficacy for coping with that stressor. It is also worth noting that the amount of attention to pain does not appear to be the sole determinant of a pain experienced at a given level of physical stimulations, since research has been reported in which a coping technique consisting of focusing attention on pain sensations is superior to verbal-imaginal distraction techniques (Leventhal, 1983). Clearly the experience of pain is a complex phenomenon in which factors other than self-efficacy and attention to pain are involved. For instance, it would be interesting to know to what extent people devote their attention to external pain inducing stimuli, to internal interpretation of the stimuli, to painful sensation, and to the given coping strategy respectively. Understanding the mechanism by which attention achieves its effect on alleviating pain would be of value in devising more effective strategies to help people deal with pain. However, in this study no direct measurement on attention was made, so it was not possible to test these possibilities directly.

Anticipated pain, which was thought to be indicative of outcome expectancy, was modestly predictive of subjective pain at the second and third assessment phases, and was correlated more highly with pain tolerance at all three assessment phases. Anticipated pain was also correlated with self-efficacy to a highly significant and strong extent. Partial correlation analyses revealed that when anticipated pain was partialed out, the correlations between self-efficacy and tolerance time were significant at the second and third assessment phases. In contrast, when self-efficacy was held constant, the correlation between anticipated pain and tolerance was modestly significant only at the pre-manipulation phase, and thereafter lost its power to predict tolerance independent of self-efficacy. These findings support Bandura's position that self-efficacy perceptions are not simply a function of outcome expectations, but influence pain coping behavior in their own right. The fourth hypothesis was thus confirmed.

The present findings, combined with those of Goldbach (1988) and Kinney (1987), suggest at least four clear directions for additional research. First, the present experiment should be replicated without the pretreatment cold pressor test. This would permit testing how enduring the effects of false biofeedback information are on tolerance and self-efficacy after subjects are given an authentic coping strategy. A related methodological issue is Litt's (1988) instruction to biofeedback subjects to perceive their hand as feeling warm. This instruction poses little problem when the purpose of the experiment is to evaluate false biofeedback effects alone. However, it becomes a potential problem when the purpose is to evaluate the effects of false biofeedback followed by authentic distraction-related coping skills, as in the present study. This is because good hand-warming biofeedback subjects might discount their biofeedback results when subsequently they are unable to perceive their hand as warm because they are having to concentrate on either verbal-imaginal or performance distraction tasks. Therefore, an improved version of the present experiment should modify the biofeedback instruction to subjects to imply that the biofeedback indicates inherent handwarming ability independently of any particular cognitive activity. Of course, the credibility of such a modified set of instruction would have to be carefully tested prior to implementing the experiment.

Second, the advantage of the overt performance coping strategy over the verbal-imaginal coping strategy requires closer analysis to determine what aspect of overt performance is responsible for its superior effects. Is it that the electronic game is visually engaging (which could be tested, e.g., by comparing it to an entertaining videotape) or that it involves manual manipulation (which could be tested by comparing it to a jigsaw puzzle), etc.

Third, the role of attentional processes needs to be studied by measuring attention directly, such as by a divided attention tracking task or by gathering think-aloud protocols that could indicate the extent to which subjects attend to pain stimuli, pain sensation and/or pain coping task as mentioned earlier. Moreover, attention per se might well be responsible for the advantage of the performance based coping technique over the alternative coping strategies tested here. To the extent that the performance coping strategy is more successful than the other techniques, this is possibly due to its being more successful in diverting attention from the pain. This possibility cannot be evaluated directly without some means of measuring subjects' attention to pain.

Fourth, some control subjects from the first and second cold pressor tests should be reassigned to the real coping treatment conditions prior to their third cold pressor test. Doing so would allow the exploration of the effects of real pain coping skills both with and without previous effects of false biofeedback. The relationship of the treatment effects between belief manipulation and authentic coping techniques would then be manifested more clearly.

Exploration of these various issues should advance understanding of the role of self-efficacy and attention in pain tolerance. This should help considerably in the development of powerful methods of helping people cope effectively with acute severe pain.

Table 1. Mean Scores on the Various Measures at the First and Second Assessment Phases, by Biofeedback Condition.

Measure/Treatment Group	ASSESSMENT 1 M	ASSESSMENT 1 SD	ASSESSMENT 2 M	ASSESSMENT 2 SD
Tolerance Time (% of 6 min.)				
Good Handwarming	26	9	35	20
Poor Handwarming	32	16	35	24
Control	37	20	33	21
Self-efficacy Strength (0-100)				
Good Handwarming	24	11	32	15
Poor Handwarming	21	14	23	12
Control	30	28	30	26
Self-efficacy Level (0-100)				
Good Handwarming	35	22	44	22
Poor Handwarming	29	19	37	18
Control	41	35	43	31
Subjective Pain (0-10)				
Good Handwarming	6.8	1	6.8	1
Poor Handwarming	7.4	1	7.3	1
Control	7.9	1	7.4	1
Anticipated Pain (0-10)				
Good Handwarming	8.8	1	8.6	1
Poor Handwarming	9.0	1	8.8	1
Control	8.8	1	8.5	1

Table 2. Significance of Changes in the Various Measures as a Function of Biofeedback Condition.

Comparison	Stat(df)	Tolerance	Subjective Pain	Self-efficacy Strength	Self-efficacy Level	Anticipated Pain
Within Group Changes						
Good Handwarmer	*t*(11)	-1.63	- .05	-3.02*	-2.12	1.09
Poor Handwarmer	*t*(12)	- .69	.58	- .92	-2.24	1.92
Control	*t*(8)	1.10	1.79	.30	- .76	3.35**
Intergroup Differences						
Good vs. Poor	*F*(1,31)	1.36	.10	3.43	.11	.07
Good vs. Control	*F*(1,31)	3.98	2.01	5.90*	1.69	.55
Poor vs. Control	*F*(1,31)	.90	1.34	.58	1.03	.26

Note: Stat = statistic; Good = good handwarming biofeedback;
Poor = poor handwarming biofeedback.

*$p < .05$. **$p < .01$.

Table 3. Mean Scores on the Various Measures at the Second and Third Assessment Phases, by Coping Strategy Condition.

	ASSESSMENT 2		ASSESSMENT 3	
Measure/Treatment Group	M	SD	M	SD
Tolerance Time (% of 6 min.)				
Performance	37	16	62	27
Verbal-imaginal	33	27	49	34
Control	33	20	33	21
Self-efficacy Strength (0-100)				
Performance	27	15	34	14
Verbal-imaginal	28	23	29	24
Control	25	25	27	24
Self-efficacy Level (0-100)				
Performance	35	20	47	17
Verbal-imaginal	38	28	40	30
Control	36	29	37	28
Subjective Pain (0-10)				
Performance	7.7	1	7.3	1
Verbal-imaginal	6.3	1	6.6	1
Control	7.4	1	7.3	2
Anticipated Pain (0-10)				
Performance	8.9	1	8.6	1
Verbal-imaginal	8.5	1	8.5	1
Control	8.7	1	8.7	1

Table 4. Significances of Changes in the Various Measures as a Function of Strategy Condition.

Comparison	Stat(*df*)	Tolerance	Subjective Pain	Self-efficacy Strength	Self-efficacy Level	Anticipated Pain
Within Group Changes						
Performance	*t*(12)	-4.32**	3.78**	-4.07**	3.76**	3.15**
Verbal-imag.	*t*(11)	-1.98	1.28	- .07	- .45	- .07
Control	*t*(8)	.11	- .29	- .10	-1.58	.12
Intergroup differences						
Perf vs. Verb	*F*(1,31)	1.03[a]	6.16*	5.72*	6.54*	2.94
Perf vs. Con	*F*(1,31)	7.30*	10.20**	6.86*	4.04*	2.01
Verb vs. Con	*F*(1,31)	3.01	.78	.16	.12	.03

Note: Stat = statistic; Perf = performance; Verb = verbal-imaginal; con = control

*$p < .05$. **$p < .01$.

a Because of a markedly skewed distribution, this comparison was recomputed using the distribution-free Mann-Whitney *U* test, which revealed that the difference between the two groups closely approached conventional levels of significance ($p < .06$).

Table 5. Intercorrelations Among the Various Measures by Assessment Phases.

	Pain Tolerance	Subjective Pain	Anticipated Pain
Self-efficacy Level			
Assessment 1	.43***	.18	-.80***
Assessment 2	.71***	-.17	-.84***
Assessment 3	.66***	-.17	-.84***
Anticipated Pain			
Assessment 1	-.52***	-.01	
Assessment 2	-.71***	.32*	
Assessment 3	-.50***	.35*	
Subjective Pain			
Assessment 1	.42**		
Assessment 2	-.03		
Assessment 3	-.01		

Note: _df_ = 32. Only the results for self-efficacy level are reported because the pattern of significant findings was identical for both efficacy level and efficacy strength.

*$p < .05$. **$p < .01$. ***$p < .001$.

Figure 1. Mean changes in pain tolerance as a function of false biofeedback condition.

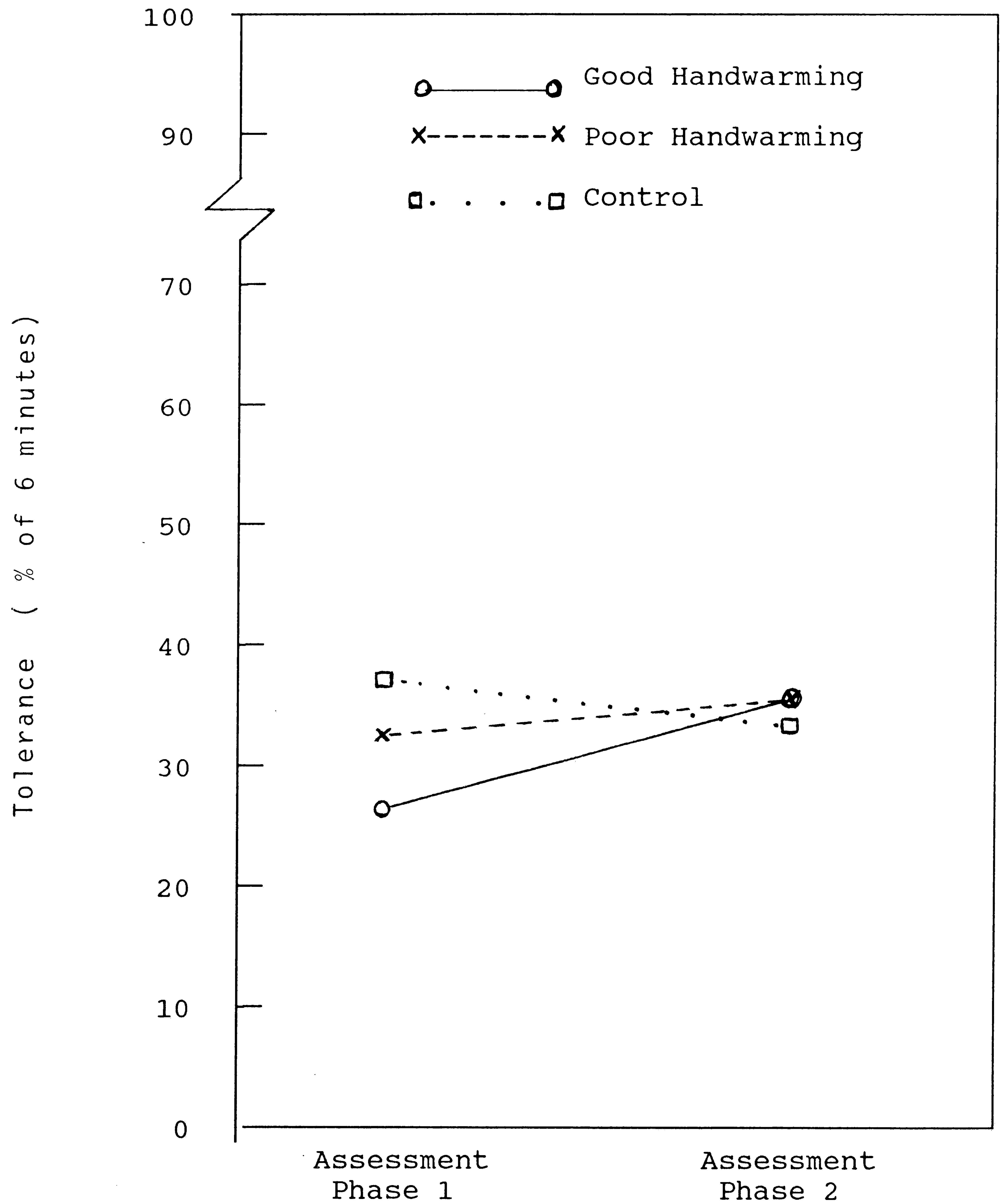
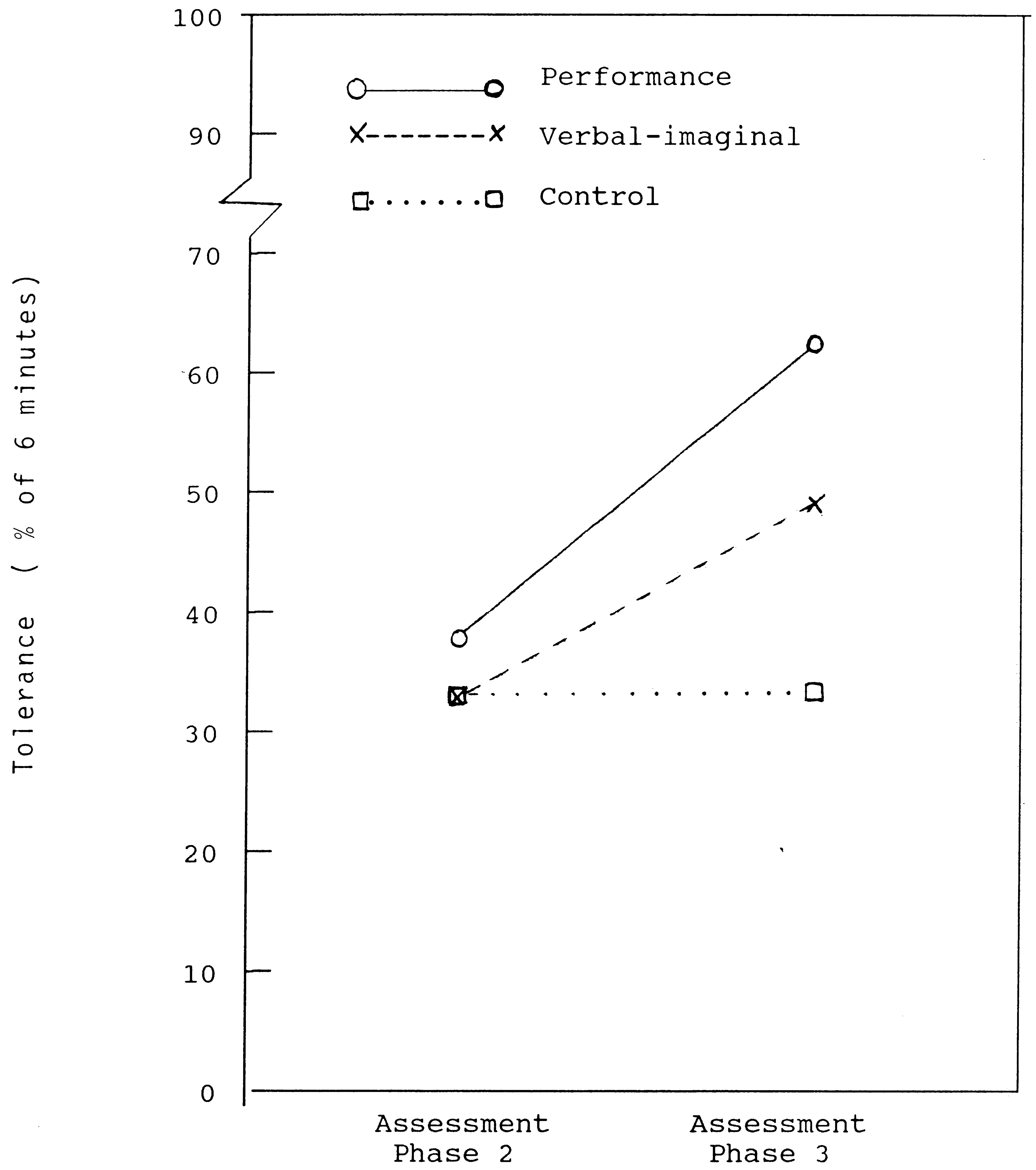


Figure 2. Mean changes in tolerance as a function of coping strategy condition.



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APPENDIX A

EXPERIMENTAL DESIGN

DESIGN OF EXPERIMENT

Preliminary Procedures

First Assessment Phase

(Random Assignment)

Good Handwarming Biofeedback	Poor Handwarming Biofeedback	No-Treatment Control

Second Assessment Phase

(Random Assignment)

Verbal-imaginal Coping Strategy	Performance Coping Strategy	No-Treatment Control

Third Assessment Phase

APPENDIX B

SELF-EFFICACY SCALE

CONFIDENCE SCALE

0	10	20	40	50	60	70	80	90	100
cannot do	quite uncertain			moderately certain					certain

How confident are you that you could keep your hand in the ice water for the periods of time listed below if you were asked to do so right now?

	CONFIDENCE (0-100)
20 sec.	________
40 sec.	________
1 min.	________
1 min. 20 sec.	________
1 min. 40 sec.	________
2 min.	________
2 min. 20 sec.	________
2 min. 40 sec.	________
3 min.	________
3 min. 20 sec.	________
3 min. 40 sec.	________
4 min.	________
4 min. 20 sec.	________
4 min. 40 sec.	________
5 min.	________
5 min. 20 sec.	________
5 min. 40 sec.	________
6 min.	________

APPENDIX C

ANTICIPATED PAIN SCALE

ANTICIPATED PAIN SCALE

0	1	2	3	4	5	6	7	8	9	10
not painful					moderately painful					very painful

How much pain do you think you would feel if you were to keep your hand in the ice water for the following periods of time?

	PAIN (0-10)
20 sec.	________
40 sec.	________
1 min.	________
1 min. 20 sec.	________
1 min. 40 sec.	________
2 min.	________
2 min. 20 sec.	________
2 min. 40 sec.	________
3 min.	________
3 min. 20 sec.	________
3 min. 40 sec.	________
4 min.	________
4 min. 20 sec.	________
4 min. 40 sec.	________
5 min.	________
5 min. 20 sec.	________
5 min. 40 sec.	________
6 min.	________

APPENDIX D

SUBJECTIVE PAIN SCALE

SUBJECTIVE PAIN SCALE

10 - Extremely painful

9

8 - Very painful

7

6

5 - Moderately painful

4

3

2 - Slightly painful

1

0 - Not painful

APPENDIX E

BIOFEEDBACK SCRIPT

Biofeedback Script

Now, I am going to give you a brief period of training in hand-warming biofeedback. Because the pain induction procedure involves you placing your hand into a tub of ice water, if you can effectively warm your hand the next time you have it immersed, you will feel less cold, and thus you will feel less pain. I am going to hook your hand up to the biofeedback machine by taping this thermister to your hand to see how capable you are of increasing your hand temperature.

I am going to take a baseline reading of your hand temperature for 2 minutes to see how warm your hand is in its natural state. (After the 2 minutes have passed): There is no known method of increasing hand warming that seems to work for all people. The best thing I can tell you to do while you are hooked up to the machine is to perceive your hand as feeling warm. Once the process is set in motion, people who are good hand warmers seem to be able to effectively keep their hand warm. So essentially, you should just perceive your hand being warm. Now that we have a baseline reading, I am going to turn on the biofeedback tone you will be hearing while you are practicing hand warming. You will hear a tone that will indicate that you are effectively warming your hand. The tone will remain on when you have raised your hand temperture by 0.5 degree F. In other words, the more frequently you hear the tone, the better you are warming your hand, and thus a steady tone would mean you were showing good hand warming ability. OK? Is all of this clear? Okay then, now you can practice for 5 minutes and see how good a hand warmer you are. It may help if you first sit back, close your eyes, and relax while your are practicing. You may begin now.

APPENDIX F

PERFORMANCE TREATMENT SCRIPT

Performance Script

Pain is an experience that all people share and our experience of it is influenced by different factors. One factor is the physical cause of the pain which creates painful sensations that hurt, but another very important factor is how much attention we focus on the pain we experience. Painful sensations will bother us less if we concentrate on something else other than the pain.

One way to reduce pain is to try and distract ourselves as much as possible. One of the best ways to distract ourselves is to have some sort of activity such as a electronic game. I am going to take some time to teach you how to operate a simple electronic game, and will then give you some time to practice it on your own. Then we will try the other cold water test.

(Subjects will be taught basic operation of game, object of game, watch the experimenter play it, and then be allowed several practice trials at playing it. They will then be left to practice alone, up to a total of 10 minutes, including time of instructions).

APPENDIX G

VERBAL-IMAGINAL TREATMENT SCRIPT

Verbal-imaginal Script

Pain is an experience that all people share and our experience of it is influenced by different factors. one factor is the physical cause of the pain which creates painful sensations that hurt, but another very important factor is how much attention we focus on the pain we experience. painful sensations will bother us less if we concentrate on something else other than the pain.

One way to reduce pain is to try and distract ourselves as much as possible. One of the best ways to distract ourselves is to concentrate on something like mental arithmetic or imaging vivid pleasant scenarios. If you do not think about the pain you will not feel it as much. I am going to teach you several ways to distract your thoughts from the ice water. I want you to use one of these methods the second time you have your hand in the ice water.

One technique you can use is refocusing attention onto mentally engrossing activities. Concentrating on performing some mental task that takes a lot of concentration such as naming all the states starting on the West coast and working your way East, or counting backward from 1000 by sevens. In this way you can reduce pain.

Another is the use of vivid imagery. People can remove themselves from their present situation by using their imagination to place themselves in more pleasant situations. You can use your imagination to direct your attention away from the cold in your hand. Try to remember a pleasant scene from your past as vividly as possible; try to remember where you were, who you were with, what you did on your first day at college, or on your last birthday. We are all capable of using imagery to refocus our attention so pain does not bother us as much.

A third technique is called dissociation. This means mentally separating the body part that is in pain from the rest of your body. Imagine that your hand is made out of something that is completely insensitive to pain such as rubber or wood and has no pain. Tell yourself that the hand in the water is someone else's, since it does not belong to you, you cannot feel anything that happens to it. Dissociation is another way you can use your mind to help relieve pain.

Now I would like you to choose one of these strategies you think would work best and concentrate on it the next time you have your hand in the ice water.

APPENDIX H

CONTROL GROUP INSTRUCTION

Control Group Instructions

I would like you to relax for 5 minutes so I can see exactly how long you can keep your hand immersed in the cold water after a period of rest. Sometimes after a period of rest people can tolerate pain better. I would like you to simply sit here and rest for 5 minutes before you do the next cold water test. You can read magazines if you want.

APPENDIX I

DEBRIEFING STATEMENT

Debriefing Statement

(At this point, the experimenter will attempt to discern whether the subject knew the biofeedback procedure was a hoax. The experimenter will ask the subject if she has any questions, and if each aspect of the procedure was clear to her. She will be told it would be helpful if she would comment on how the experiment struck her, why she responded as she did, how she felt about the procedure, etc. Then subjects will be asked specifically if there was any aspect of the procedure that was odd, confusing, or disturbing. By this point, it will be very likely that the subject will reveal any suspicions she had. If no suspicions have been expressed, the experimenter will ask if the subject thinks there may have been more to the experiment than meets the eye. If the subject responds affirmatively, as many will after this suggestion, the experimenter will ask the subject to explain what might have been involved in addition to what she has been told. From the subject's answers to this question, the experimenter can make a judgement as to how close a subject's suspicions were to the actual purpose of the experiment). Then:

"Pain is a major cause of human suffering and thus it is vital to know how psychological factors contribute to it if we as psychologists are to help people who suffer from painful affictions. That is why we have purposely, after the first cold pressor test, given you false biofeedback concerning your ability to warm your hand. In fact, the beeps you heard were provided by a tape recorder, and they were the same for you and for many other participants, regardless of actual hand warming ability. The reason you were led to believe you were either effectively or ineffectively warming your hand was to see what effect your perception of your ability to warm your hand had on your confidence ratings, and what effect it might have on your subsequent pain tolerance. We do not enjoy misleading people who take part in this experiment, but there really is no other way to answer the important questions we would like to investigate. The false biofeedback was aimed to function as a kind of placebo suggestion that one is either an effective or ineffective hand warmer. If we can learn more about whether and how such suggestions can help people cope with pain, it would help us understand the psychological aspects of pain. It would be advantageous to know if suggestions affect your confidence in your pain tolerance ability, something we call "self-efficacy", or some other variable. The value of this is that some chronic pain sufferers cannot take, or do not want to take medication all the time. Understanding more about psychological processes in pain coping strategies and placebos will help us to provide relief from pain to individuals who cannot or will not take drugs. We can also see how placebo effects influence, or do not influence, genuine pain coping strategies like the ones used in this experiment. Through your participation you have indirectly helped provide the information we need to help others, and your participation is very much appreciated. We spent a great deal of time and effort in order to make this false biofeedback procedure seem genuine. We have been very successful at making people think they really are experiencing hand-warming feedback, so there is nothing gullible about you. It is just that we have been very thorough and careful in designing this part of the experiment. Also, your data will be completely anonymous from this point on. (Reference list will be provided to those subjects who wish to prusue this topic further). If you would like to learn more about psychological processes involved in pain tolerance I can provide you with a list of references for articles that are in our libraries here at Lehigh. These can tell you more about this subject. Do you have any questions or comments about anything we've done today during this experiment?

(The experimenter will take as much time as necessary to explain the necessity of the deception to the subject, to listen and respond in a friendly and empathic manner to any complaints by any subject, and to make certain that all subjects leave the experiment being on good terms with the experiment. In fact, the experimenter will ask subjects at the completion of the debriefing if they have any suggestions concerning how the experiment could be improved, explaining that experimenters are always looking for ways to make their procedures more credible and more pleasant for the subject. The experimenter will tell subjects that he/she would appreciate the subjects pointing out any weaknesses they saw in this regard. This will not only potentially help us to refine our procedure, but will enhance the friendly relationship between the subject and the experimenter). Then:

"Please don't discuss the procedure of this experiment with anyone".

(The experimenter will emphasize the importance of secrecy to subjects. The experimenter will point out what a huge waste of time, effort and money it would be if participants came to the experiment knowing in advance what to expect. The experimenter will explain to the subject that the scientific enterprise would be damaged by drawing conclusions from a study that had participants who knew what was going to happen in the prodecure beforehand. The experimenter will emphasize that information spreads rapidly and thus telling even one other person could significantly damage the experiment.) Finally:

"Would you like to receive a copy of the results when we know them? (The address of those answering in the affirmative will be taken). Thank you very much for helping out. Good luck at Lehigh."

CURRICULUM VITAE

Zi Fan

I. Biographical:

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II. Education:

College Degree	Majored in English Teaching, 1973-1976 Normal Institute of Foreign Languages Beijing, China
	Majored in English Literature, 1978-1980 Beijing University. Beijing, China.
Undergraduate:	B.A. in Linguistics 1982 University of California, Irvine Irvine, Ca. U.S.A.
Graduate:	M.A. in social Sciences 1984 University of California, Irvine Irvine, Ca. U.S.A.
	Ph.D. in Psychology Lehigh University (Ph.D. 1990 expected) Bethlehem, PA U.S.A.

III. Teaching Experience:

A.	English Teacher:	Bao Hua Li School, Beijing, China 1977-1978
B.	Lecturer:	Beijing University (1984-1986) Psychology Department
	Courses taught:	Major English Psychological Assessment Statistics

C. Lecturer: Lehigh University (Summer, 1988)
Psychology Department

Course taught: Personality Theory

D. Teaching Assistant: University of California, Irvine (1983-1984)

Statistics

Lehigh University (1986-present)

Introduction to Psychology
Personality Theory
Abnormal Psychology
Cognitive Psychology
Industrial Psychology
Psychology and Law
Learning and Memory
Psychological Assessment
Experimental Design
Clinical Psychology

IV. Research Interests:

1. The psychological factors mediating individual's ability to cope with pain.

2. How dynamics of stress and coping change an individual's psychophysiological status.

V. References:

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